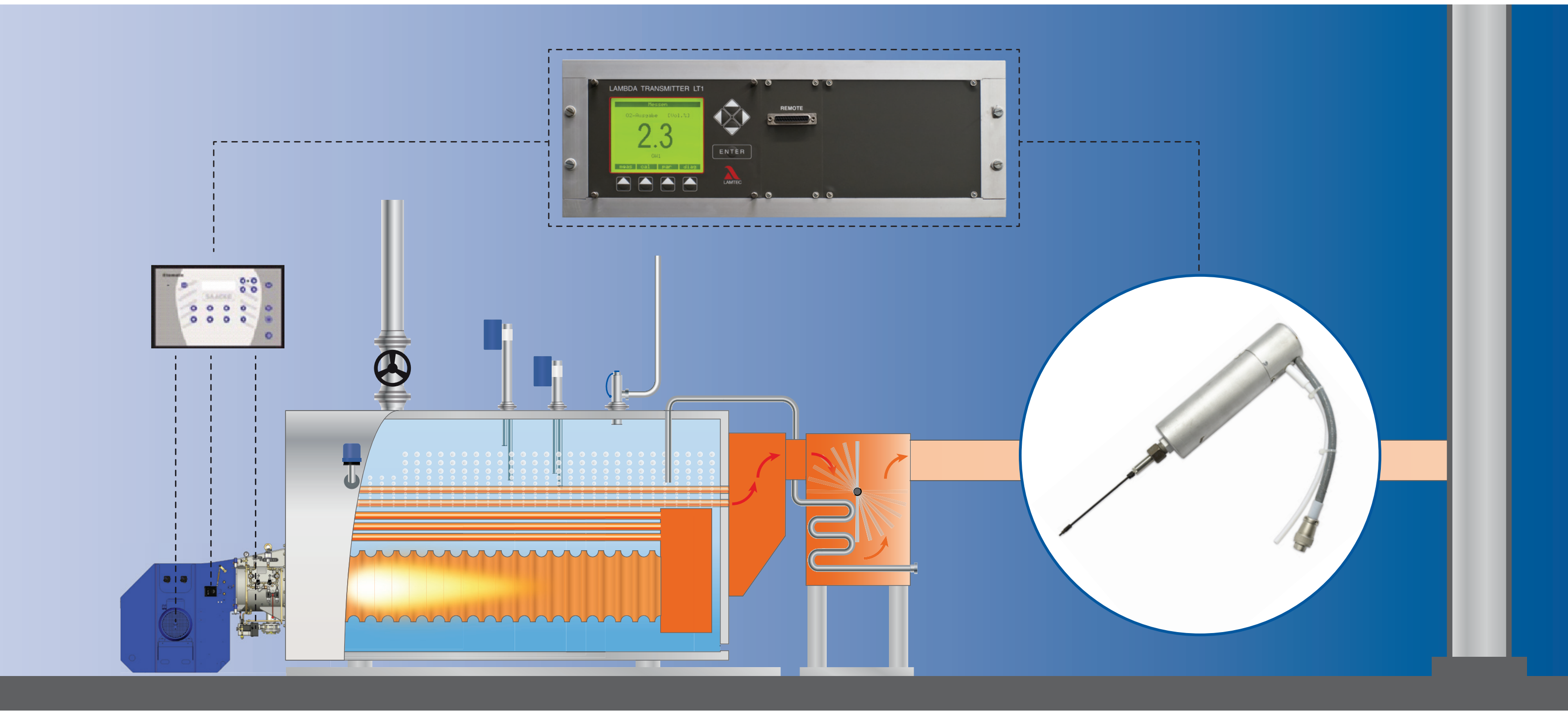

Determining O_2 – increasing efficiency and operational reliability

A conventional combustion system operates with excess air so it can guarantee reliable and clean combustion even under fluctuating ambient and fuel conditions. The set values for fuel and air are rigid and do not adapt to the naturally varying environmental conditions.

An O_2 control determines the actual oxygen concentration in the flue gas and ensures that the fuel-air ratio is always constant. As a result, combustion is always clean and residue-free even with minimal air surplus – regardless of disturbance variables. With O_2 control the efficiency of existing systems can be improved by approx. 1 %.

Fluctuations in following disturbance variables have an influence on combustion because of weather changes or changes in fuel condition:

- Pressure, temperature and moisture of the ambient air
- Lower heating value, density, viscosity and temperature of the fuel

Changes of O_2 concentration due to disturbance variables

Variables	Influence on O_2 concentration
Combustion air temperature about 10 K	0.5 - 0.7 %
Atmospheric pressure about 20 mbar	0.4 %
Lower heating value about 5 %	+/- 1.4 %

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O_2 determination also provides additional safety: when defined O_2 limits are reached, the combustion system can be shut down. Dangerous operating states can thus be avoided. The core of this measuring technology is a low-maintenance zirconium dioxide lambda probe that continuously monitors the moist flue gas and is installed as close to the combustion chamber as possible in the flue gas duct. The direct, close measurement is the basis for rapid and flexible control.

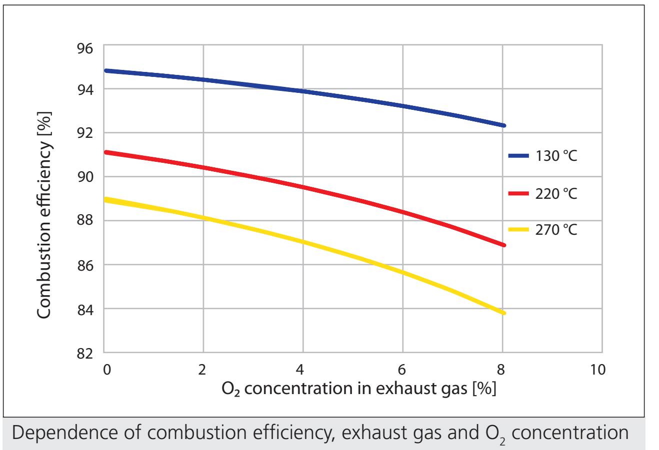
This O_2 measurement offers an optimally adapted and proven control system in interaction with all electronic SAACKE burner control systems, e.g. se@vis. O_2 controls can be smoothly integrated into new and just as easily installed in existing combustion systems and offer a number of advantages (see on the right).

Combination with CO control

In theory a combustion system with an excess air factor of $\lambda = 1$, i.e. without any excess air, should be exceptionally efficient since minimal flue gas losses would theoretically result. In fact, however, industrial combustion systems are generally operated with slight excess air ($\lambda = 1.1 – 1.4$). Why is that the case although excess air (due to flue gas losses) uses up valuable energy?
As one approaches the theoretically optimum excess air factor, the CO emission values unfortunately rise sharply many times over shortly before the "1". This is referred to as the "CO edge", from which it is better to keep one's distance as far as possible. An additional CO control system provides a way of minimizing the excess air and thus saving valuable fuel without falling victim to the "CO edge". A CO sensor monitors the CO emission values in the flue gas and ensures at a certain limit value that more oxygen is supplied for combustion.

Advantages of a CO control at a glance

- Suitable for all standard fuels and heat generators
- Corrects fluctuations in the fuel and combustion air
- Minimizes O_2 surplus at every load stage
- Quick response time of t < 15 s possible
- Improved system security through continuous limit value monitoring
- Low maintenance, long service life
- Average amortization period < 2 years



Dependence of combustion efficiency, exhaust gas and O_2 concentration

Example of a plant

The example below shows the efficiency of a retrofitted plant on a typical steam boiler with 10 MW gas firing. The amortization period here is less than two years – the emission values for NO_x and CO_2 improve immediately.

Example calculation boiler 10 MW, natural gas, no economizer, with O_2 control

Burner output max. MW	Exhaust temperature °C	O_2 concentration % without control	O_2 concentration % with control	Operating hours h/a	Saving* Energy kWh/a	Saving* Costs EUR/a
2	230	4.0	2.8	1,000	21,800	872
4	240	3.8	2.6	1,500	59,400	2,376
6	245	3.6	2.4	2,000	66,700	2,668
8	250	3.4	2.2	1,500	59,250	2,370
10	260	3.2	2.0	500	37,700	1,508
			Amount	**6,500**	**244,850**	**9,764**

* Unit price 0.04 EUR/KWh

For further information, please visit: **www.saacke.com**

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